

*Citation for published version:*

Ghoshray, A & Stamatogiannis, MP 2015, 'Centurial evidence of breaks in the persistence of unemployment', *Economics Letters*, pp. 74-76. <https://doi.org/10.1016/j.econlet.2015.02.012>

*DOI:*

[10.1016/j.econlet.2015.02.012](https://doi.org/10.1016/j.econlet.2015.02.012)

*Publication date:*

2015

*Document Version*

Early version, also known as pre-print

[Link to publication](https://doi.org/10.1016/j.econlet.2015.02.012)

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# Centurial Evidence of Breaks in the Persistence of Unemployment

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## Abstract

A novel procedure is applied to test for switches between hysteresis and the natural rate theory over more than a century of UK and USA unemployment data. For both the countries we see a period conforming to hysteresis starting in the early 1920s for the UK and 1930 for USA.

**Keywords:** Unemployment, Hysteresis, Unit Root, Dynamic Persistence.

**JEL:** C12, C22, E24

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# 1 Introduction

Unemployment hysteresis and the natural rate of unemployment are well known theories in the economics literature. The theory of unemployment hysteresis states that the effect of a shock, such as a recession, on unemployment is highly persistent, such that the rate of unemployment does not return to an equilibrium level. The contrasting theory is the natural rate of unemployment. This theory argues that there will always be some equilibrium level of unemployment in the labour market due to real wages being forced above the market-determined level by legislation such as minimum wage laws. The actual rate of unemployment is, however, subject to temporary fluctuations around this natural rate according to inflationary expectations. If inflation is higher than expected, there will be temporarily lower real wages than expected and unemployment may fall in the short run, but it will revert back to the natural rate once expectations have been corrected. Also found in the theory is the “non-accelerating inflation rate of unemployment”, which is a specific form of the natural rate, where inflation expectations are static.

A number of studies have identified the idea of hysteresis being consistent with unemployment being a unit root process. It follows that rejecting a unit root is consistent with the natural rate hypothesis. However, it is important to note the structuralist view; that unemployment is stationary but around a natural (or ‘structural’) rate. Recent developments in unit root techniques have contributed to the large volume of empirical work on this subject.

A major drawback of almost all past studies is that they are restricted to the dichotomy of concluding natural rate or hysteresis, due to the specification of their null and alternative hypotheses. When considering a century of unemployment data, it is highly likely that there could be a switch (or possibly more) between hysteresis and the natural rate.

This paper intends to address this drawback by applying a recent and novel test for multiple changes in persistence put forward by Kejriwal et al. (2013) (KPZ hereafter) to unemployment data for USA and UK covering a time span over a century. The test allows for one or more switches in the order of integration between  $I(0)$  and  $I(1)$ , and can therefore endogenously locate the periods characterized by hysteresis and those characterized by the natural rate. We find the break in unemployment persistence to be in tune with deep recessions and this note would provide valuable insights into the relevant unemployment theories.

## 2 Limitations of Past Studies

Empirical studies on unemployment hysteresis have evolved in line with the advancement of unit root tests. However, most of the studies (see references within Lee and Chang, 2008) are all restricted to the dichotomy of concluding natural rate or hysteresis, which seems rather restrictive when analyzing data that spans for more than a century.

Multivariate analyses in the form of panel unit root tests can also be found in the literature such as Romero-Ávila and Usabiaga (2007). As with univariate tests, structural breaks have been a progression in panel unit root techniques, such as the Carrión-i-Silvestre et al. (2005) test, that allow for different number of structural breaks in each country or region. Camarero et al. (2008) use this test on data for transition countries in Eastern Europe. Panel data techniques may appear appealing in the presence of limited observations, as they increase the power of the tests involved. However, a major drawback is an arbitrary selection of countries included in panels simply for the sake of added observations making it hard to interpret the results.

Another group of studies on unemployment hysteresis have taken into account the possibility of fractional integration in the rate of unemployment (see Caporale and Gil-Alana, 2009). The reason for using this test is that standard unit root tests are said to lack power in the presence of an alternative fractional form. While statistically the fractional approach is useful, a criticism would be that it cannot give a definitive conclusion about the two theories of unemployment. With a fractional order of integration, say  $d$  ( $0 < d < 1$ ) one must define some cut-off value of  $d$  below which we should conclude that the natural rate theory is appropriate.

The only study to date that allows for switches between hysteresis and the natural rate is by Fosten and Ghoshray (2011) where they use the method of multiple changes in persistence due to Leybourne, et al. (2007). However, a major drawback of this procedure is that the initial regime is a unit root process. In a recent paper, KPZ advocate a superior procedure which allows for identification of the initial regime. We intend to allow for regime switches by using the KPZ test, which to our knowledge has not been applied to unemployment data. Unlike previous studies, this approach will allow to escape the  $I(0)/I(1)$  dichotomy, identify the sub-periods over which the series have conformed to the natural rate or hysteresis hypotheses, and the regime dates will be endogenously determined.

### 3 Econometric Methodology

In this study we allow for an intercept in the stationary regimes, so we consider a scalar process  $y_t$  which is generated by

$$y_t = c_i + \alpha_i y_{t-1} + u_{it}$$

for  $t \in [T_{i-1} + 1, T_i]$ ,  $i = 1, \dots, m + 1$ ,  $T_0 = 0$ ,  $T_{m+1} = T$ , where  $T$  being the sample size. Consequently,  $m$  breaks in the persistence and  $m + 1$  regimes are considered. The error sequence  $u_{it}$  is assumed to be a stationary linear process.

Following KPZ we test the null hypothesis that a process is  $I(1)$  throughout the sample:

$$H_0 : c_i = 0, \alpha_i = 1,$$

against the alternative of multiple structural change in persistence. Depending on the degree of persistence in the first regime, two models are considered under the alternative:

$$\begin{aligned} H_{1a} & : \alpha_i = 1 \text{ in odd regimes and } |\alpha_i| < 1 \text{ in even regimes,} \\ H_{1b} & : \alpha_i = 1 \text{ in even regimes and } |\alpha_i| < 1 \text{ in odd regimes.} \end{aligned}$$

To account for possible autocorrelation of the residuals, KPZ suggest the use of the following regression

$$\Delta y_t = c_i + (\alpha_i - 1) y_{t-1} + \sum_{j=1}^{l_T} \pi_j \Delta y_{t-j} + \epsilon_t \quad (1)$$

under the null and the alternative, for the calculation of the Wald statistic for a fixed number of breaks  $m = k$  and a given degree of persistence in the first regime. The choice of the lag-length  $l_T$  is based on the Bayesian Information Criterion (BIC) applied on the full-sample estimation of equation (1). Subsequently, the algorithm of Perron and Qu (2006) is employed for the calculation of the sup-Wald test ( $F_{1a}(k)$  for  $H_{1a}$  and  $F_{1b}(k)$  for  $H_{1b}$ ) which minimizes the global sums of squares. The second type of test considers the persistence in the first regime as unknown and is calculated as  $W_1(k) = \max[F_{1a}(k), F_{1b}(k)]$ . Finally, a third test treats the number of breaks as unknown and is given by  $W_{\max_1} = \max_{1 \leq m \leq A} [W_1(m)]$ , where  $A$  is the maximum number of breaks considered. We opt to use the  $W_{\max_1}$  test in order to avoid imposing a priori arbitrary restrictions on both the number of breaks and the nature of the persistence in the first regime. The maximum number of breaks  $A$  is set to be five.

## 4 Data and Empirical Results

We use annual data for the UK and USA unemployment rates collected from the volumes of “International Historical Statistics 1750-2005” and updated to 2012 from the International Labour Organization. The results of the  $W_{\max_1}$  test of KPZ are shown in Table 1.

**Table 1**

KPZ test for change in persistence

Country	Sample	Order of integration	$W_{\max_1}$
UK	1855-1922	I(0)	21.708***
	1923-2012	I(1)	
US	1890-1930	I(0)	11.064**
	1931-2012	I(1)	

\*\* and \*\*\* imply rejection of the null at the 5% and 1% level respectively

In the case of UK, we find one break in 1922 demarcating two regimes, where the initial regime is I(0) from 1855 to 1922, and then switching to I(1) for the remaining period 1923 to 2012. For USA, we also find one break located in 1930, and therefore two regimes. The initial regime is I(0) from 1878 to 1930 followed by an I(1) regime from 1931 to the end of the sample.<sup>1</sup> According to the BIC the lag-length of (1) is set equal to one.

When considering dynamic persistence in regimes we find remarkable similarity between the nature of unemployment persistence between UK and USA and it is possible to suggest clearer predictions about the results. In the early 1920s the UK and the USA experienced macroeconomic shocks, which seem to have been broadly similar in magnitude, and from which the USA recovered rather better than the UK. There was a distinct increase in the equilibrium unemployment rate in the UK in the 1920s associated with increased union militancy, the development of centralized but uncoordinated wage setting, and the advent of a national system of unemployment insurance; besides the UK recovery in the early 1920s was also hampered by the sharp cut in working hours (Hatton and Thomas, 2010). By contrast, such institutional developments were largely absent in USA and the fall in working hours was more easily accommodated. As a result of the combination of shocks and labour market institutions, unemployment persistence appeared around 1922 for UK and 1930 for USA. Before World War I and the interwar

<sup>1</sup>We also run the KPZ test allowing for an intercept and a trend in the stationary regimes and the results (in terms of the number and the date of the breaks) remain the same.

period labour markets were relatively fluid with high labour turnover and relatively transitory unemployment; however, institutional change weakened the labour market equilibrating mechanisms (Hatton and Thomas, 2010).

Our results differ from those of past studies that test for unemployment hysteresis for over a century. Blanchard and Summers (1986) find evidence of hysteresis while Bianchi and Zoega (1997) find unemployment to be stationary around an infrequently changing mean that coincides with shocks such as World War II and the oil shocks of the 1970s. Lee and Chang (2008) reject hysteresis accounting for structural breaks, and Caporale and Gil-Alana (2009) conclude stationary mean reverting unemployment in response to shocks to the UK and USA unemployment data. Our results for USA are similar to that of Fosten and Ghoshray (2011), but depart markedly for UK, where they find multiple  $I(0)$  regimes.

## 5 Conclusion

Using the recent test of KPZ, we find that UK and USA unemployment over a century of data is subject to a switch from  $I(0)$  to  $I(1)$  suggesting a move away from the natural rate to hysteresis. Our findings reveal a period conforming to hysteresis which takes over in the early 1920s for the UK and 1930 for USA.

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